# JOURNAL

OF THE

AMERICAN FOUNDRYMENS' ASSOCIATION.

VOL. 6. FEBRUARY, 1899. NO. 32.

The American Foundrymens' Association is not responsible for any statement or opinion that may be advanced by any contributor to this Journal.

PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The Pittsburg Foundrymen's Association held its regular monthly meeting in the Frohsinn Building Monday evening, January 23. The evening was devoted, with some digressions, to a very interesting discussion of Dr. Phillips' paper on the yard grading of pig iron, read at the December meeting. It was claimed that if the foundrymen required the furnacemen to sell their pig iron on analysis there would be no difficulty in arranging the matter; but it was well recognized that the foundrymen would first have to find out exactly what they wanted, and it became a question of the effect of the different elements on the behavior of iron. Many foundrymen bought iron on a silicon analysis, but there were other important elements and silicon was not all. It was pointed out that furnaces frequently had "off" casts, which they could not sell to the regular trade, but frequently were just the thing wanted for certain classes of foundry work; and it would evidently be a wise move for foundrymen to learn just what they could use in this direction, and then look for such lots, as they could be secured at a concession in price and the furnacemen would still be pleased. It was thought

better for the furnacemen to prepare lists of the iron on hand, or which could be furnished, giving the analyses, rather than that the foundrymen should send out lists to brokers and others of what they might require, as valuable information might occasionally leak out that way.

When the discussion branched out into the effect of manganese on the cupola lining there was an interesting interchange of views in regard to Bessemer practice also. The chemist of a prominent Pittsburg steel works stated that seven or eight years ago he had formed a theory as to skulling in the converter, which was that if the manganese in the pig iron went below 0.4 there would be skulling, but if kept above that limit there would be no trouble from this source. He was not so much interested in the nature of skulling as in the practical means to prevent it; and for the past five years the experience at the steel works had been in full corroboration of his theory. There was objection to buying iron high in manganese, because it was all lost so far as the product was concerned, and it meant paying for something which did not appear in the steel, but considering the cost of removing the skulls and the loss of product during the time the vessel was idle, there was no question whatever about the economy of buying iron containing 0.5 to 0.6 manganese. Some blast furnaces had difficulty in furnishing such iron, as the manganese depended on the quantity present in the ore, but by securing the proper kind of ore, and mixing the proper proportion, the manganese could readily be regulated. It has been claimed that high manganese did not affect the lining of the cupola, but his experience was that beyond 0.8 or 0.9 in manganese the effect was to reduce the silica of the lining to silicon, which increased the silicon in the iron, and required constant patching of the lining.

It was objected to this theory that silica is not reducible to silicon at anything like the temperature found in such work, but on the other hand there is no proof that the presence of manganese may not have an influence, permitting the reduction to occur at a lower temperature. At any rate, the experi-

ence in the steel works in question had been that when the manganese got too high, the lining suffered greatly, and when it got too low, there was skulling.

In regard to the amount required for a cupola some interesting points were discussed. The tendency now is to drive fans faster and faster, in order to get more air and thus melt the iron faster. It was pointed out that greater tuyere area would solve the question better than driving the fans faster, or increasing the pressure of the blast. With a fan, unlike a positive blower, the actual gauge pressure is no indication of the quantity of wind going into the cupola. The pressure may be all right, but on account of contracted tuyere area very little wind may be passing. The increased speed uses up horse power very rapidly without much gain. Most of the men who run the cupolas think it is a great waste of wind to keep a slag hole open, and by having it stopped, the slag frequently gets up to the level of the tuyeres and stops some of them up, thus shutting off the wind supply. The loss of wind through a moderate sized slag hole is unimportant. Usually when more wind is required, it will be better to try increasing the size or number of the tuyeres before speeding up the fan.

It was the sense of the meeting that a great deal of good would come from a better understanding of the needs of the foundryman in regard to the chemical composition of the iron he uses, and hopes were expressed that some definite work could be accomplished by the time of the annual convention of the American Foundrymen's Association, which is to be held in Pittsburg in May, so that action could be taken based on the results.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on Wednesday, January 4, the president, P. D. Wanner, occupying the chair.

The Executive Committee reported as follows:

"It is impossible to tell at this early date what the new year will have in store for us. All of the dark clouds have passed away and the American people are at peace with all nations. The balance of trade is in our favor, and gold is coming to our shores in large quantities, therefore it would seem that a prosperous year is before us. The last year was a good one in many ways, particularly as regards foreign trade. We are told that the exports of grain, agricultural machinery, steel rails, locomotives, machinery, cast iron pipe, malleable iron castings, etc., have been greater than ever before. This, to say the least, is very satisfactory, and the iron, steel and brass foundries of this country have profited. Unusual efforts are being made looking for foreign trade, and what has once been done can be done again; therefore if all records have been broken during the past year in the shipments of the articles named above, it would seem that the year 1899 would be another record breaker. While looking for foreign trade we must not neglect our domestic trade. We have no doubt our shops and factories will depend to a greater extent on that than on export trade, and we look for a larger business than ever before, as those who have kept their money tied up in banking institutions and stockings will feel safe in making good investments. We have nothing to do, then, but to wait for further developments."

The committee having charge of the preparation of a memorial on the death of Thomas Glover, late a member of the association, made a report in the form of a memorial, which upon motion was ordered to be spread upon the minutes, and further-

more properly engrossed and forwarded to the relatives of the deceased.

The president called attention to the bill now before the United States Senate in relation to the protection of American shipping in the matter of carrying freights, and Jas. S. Stirling presented the following resolution, which was duly carried and copies ordered to be forwarded to Senators and Representatives of the State:

"Whereas, Ninety per cent. of the imports and exports of the United States are carried in foreign ships, which annually receive from the people of the United States a sum estimated at $200,000,000, which is taken out of the country in gold or its equivalent and contributes to the employment of aliens abroad, while at the same time depriving our own people of the employment that sum would constantly give if it were retained in the United States; and,

"Whereas, A bill has been introduced in the Senate of the United States (No. S. 5024) by Hon. M. A. Hanna, and in the House of Representatives (No. H. R. 11,312) by Hon S E. Payne, the purpose of which is to restore to American ships a fair share of our foreign carrying, to the end that the money so expended may be retained in the United States, giving employment upon our farms, our mines, our forests, our factories, in our shipyards and on board the ships to our own peple; therefore, be it

"Resolved, That the Foundrymen's Association favors the adoption of Senate bill No. 5024 and House bill No. 11,312, which are identical, at the present session of Congress, and respectfully requests that each of the Senators and the Representative from this district, in Congress, do their utmost to secure the passage of these bills, in the interest of the people of the entire United States and for the more adequate defense of the nation."

F. A. Riehle called the attention of the meeting to the low prices for castings existing in the foundry trade in the face of the better condition of trade in general. He believed, he said,

that the time had arrived when better prices should be insisted upon.

The chairman expressed himself as being of the same opinion and stated that at the recent letting of the contract for the supply of cast iron pipe required by the city of Philadelphia four or five of the foundrymen bidding put in prices showing $1.50 to $2 per ton advance on the prices at which the last contract was awarded. The contract was taken, however, by a founder who bid the prices which ruled last year. As far as his company were concerned they were going to ask better prices, and if all would do it some profits could be secured during the next 10 or 15 years. He thought the matter of asking higher prices for castings should come up for general discussion at the next meeting of the association.

After some discussion Joseph Thompson moved the following resolution:

"Whereas, It is the sense of this association that the selling prices of castings are and have been for some time much too low to admit of honest and reasonable profits to founders; therefore,

"Resolved, That this association recommends every foundryman to establish higher prices for castings of all kinds, and that at the next meeting of the association the subject be taken up for general discussion, and that founders not members of the association be invited to attend such meeting and make suggestions as to the best course to take to secure a general advance in prices; further,

"Resolved, That the co-operation of the other foundrymen's associations in the country be invited."

The resolution was carried unanimously.

John Birkinbine then made an address, with 68 lantern slide illustrations, on

"THE BASIS OF THE IRON INDUSTRY."

as follows:

In opening my last report to the United States Geological Survey I made the following statement: "The year which

ended December 31, 1897, was the banner year of pig iron production in the United States. The output was 9,652,680 gross tons and was also the largest ever reported by any country in one year. It is therefore natural to expect that the American iron ore industry, which supplied raw material for the manufacture of pig iron, would also reach its maximum output in 1897. This was the case. The total for the whole country reached 17,518,046 long tons of iron ore, which is 1,221,380 long tons, or 7.49 per cent., more than the former maximum of 16,296,666 long tons in the year 1892. During the year 25 States and Territories contributed to the total. The mean production for the nine years 1889-1897 was 14,932,261 long tons.

The domestic iron ore produced in 1897 represents a volume of excavation equivalent to 40 acres dug to an average depth of 100 feet. This does not include the barren earth or rock necessarily removed in exploitation. Probably 30 per cent. of the ore is won from open excavations, some of them covering many acres, and 70 per cent. is taken from underground workings, some of which exceed 1,000 feet in depth and extend long distances from slopes or shafts sunk into ore lenses or veins.

Within a few days of the close of 1898, estimates only can be offered, but it is probable that the blast furnaces of the United States produced in 1898 over 11,000,000 gross tons of pig iron, and that in the same year our domestic iron ore mines supplied about 20,000,000 gross tons of ore, a decided increase over the figures for 1897. This requires that over 50,000 tons of iron ore must be supplied daily.

All of the iron ore won is not smelted into pig iron; some of it is used as flux in silver smelting, but this is offset by cinder, zinc residuum, etc., fed to blast furnaces.

This country also imports over 500,000 tons of ore annually, Cuba and Spain, under normal conditions, being the most prominent contributors.

The average for the country is nearly 2 tons of mineral required per ton of pig iron made. Most of this mineral is mined, transported by rail or water hundreds of miles, with five or more

transfers to and from different vehicles, and when it reaches the furnaces requires a ton or more of fuel and 1-3 ton of limestone to smelt it. Both of these must also be mined or quarried and transported. Adding the labor, superintendence and other expenses, interest on large investments on the furnaces, etc., and transportation to your foundries, you may wonder how you can purchase pig iron for less than ½ cent per pound.

This is possible because of intelligent management and labor-saving appliances introduced at the mines, and the methods of handling and shipping them produced methods which are copied in other countries and recognized as the best in the world.

There are in this country ore mines 500 feet or more below the surface, where iron ore requiring blasting is broken down, loaded on tram cars, which are hauled to shafts and there elevated to the surface and delivered into railroad cars at a cost below 60 cents per ton, including timbering (some of it elaborate), explosives, labor, light and all supplies; in fact, everything but royalties and profit, the latter microscopic. The average cost of all ore mined in 1898 in the United States approximates $1 per ton on cars at the mine.

The foundries are large consumers of pig iron, but the steel plants lead in this and fully one-half of our domestic product is of Bessemer grade.

Although iron ores are found in most of the States and are mined regularly in 25 or more of them, three-fourths of the output is represented by the continued production of Michigan, Minnesota and Alabama. Pennsylvania, which now holds fourth place, was formerly the leader, but Michigan took this rank between 1880 and 1890 and has continued to hold it, being now, however, closely pressed by Minnesota. The totals show that Minnesota, which until 15 years ago contributed no iron ore, has mined in the interval 30,000,000 long tons. To obtain this, towns and villages have been located, several hundred miles of railroad built and equipped and extensive shipping docks constructed. Most of this work has been done in what was previously an unbroken wilderness.

The annual productions of the leading States may be approximated thus:

Michigan and Minnesota	6,000,000 tons each.
Alabama	2,000,000 tons.
Pennsylvania and Virginia, about	750,000 tons each.
Wisconsin and Tennessee	600,000 tons each.
New York and New Jersey	300,000 tons each.

Only about 15 per cent. of the iron ore mined is obtained from what may be called small mines—i. e., those producing less than 150 tons per day—and there are a score of mines supplying 1,000 to 2,500 tons each per working day.

The following is the record of the largest output and the total production of a few of the largest producers:

	Total production to close of 1898.	Largest Output.	Output in 1897.
Cornwall Ore Hills, Pennsylvania	14,800,000	769,020	419,468
Lake Superior Mine, Michigan	8,300,000	690,000	561,186
Norrie Mine, Michigan	7,700,000	1,000,000	561,186
Cleveland Cliffs Mine, Michigan	7,550,000	865,900	536,000
Chapin Mine, Michigan	7,200,000	742,843	354,559
Minnesota Mine, Minnesota	6,175,000	335,318	502,738
Republic Mine, Michigan	4,700,000	277,000	124,491
Chandler Mine, Minnesota	5,110,000	914,857	586,353
Pittsburg and Lake Angeline Mines, Minnesota	4,700,000	521,100	521,100
Iron Mountain, Missouri	3,400,000	......	none
Mountain Iron and Rathbun Mines, Minnesota	......	773,588	775,588
Lone Jack and Missabe Mountain Mines, Minnesota	......	808,291	601,072
Alice, Fossil, Redding, Wares and Muscado Mines, Alabama	......	945,805	565,395
Fayal Mine, Michigan	......	565,600	565,600
Arragon Mines, Michigan	......	328,000	......

Instances of native metallic ore being found are few, most of that reported being meteoric iron, really an alloy of iron and nickel. Mexico is quite prolific in large masses of meteoric iron.

The richest ore found is magnetic, which when freed from other elements may contain 72.48 per cent. of metallic iron.

The Lake Champlain mines, New York, most of the New Jersey mines, the Cornwall ore hills of Pennsylvania, the Cranberry mines of North Carolina, are magnetites, but most of them carry sulphur, phosphorus, etc.

Next in order are the red hematites, which when pure may contain 70 per cent. metallic iron. Most of the Lake Superior ores, the Central New York, the fossil ores of Pennsylvania and the Red Mountain ores of Alabama and similar ores in Tennessee are of this class.

When hydrated the red hematites become limonites or brown hematite ores, seldom reaching 50 per cent. of iron. The Salisbury region of Connecticut and East New York, the East Pennsylvania and Cumberland Valley ores of Pennsylvania, most of the Virginia ores and some of the Alabama, Georgia and Tennessee ores are brown hematites.

The carbonate ore forms a fourth general class, from which a maximum of 48.5 per cent. is obtainable.

The Hanging Rock region of Ohio and Kentucky, the Mahoning and Shenango Valleys and some of the Western Pennsylvania and the Maryland iron industry was established upon carbonate ores.

Over 80 per cent. of the ores now used in the United States are red hematites. Only about one-half of 1 per cent. are carbonates; the balance is divided between brown hematites and magnetites in the proportion of about 2 tons of the former to 1 ton of the latter.

The slides shown were very interesting and covered the handling of ores from the mine to the blast furnace. The running descriptions furnished by the speaker were very complete and his listeners carried away with them some good ideas as to the immensity of the traffic in ores on land and water before they reach the furnaces.

On the conclusion of the address a hearty vote of thanks was presented to Mr. Birkinbine.

A REVIEW OF THE FOUNDRY LITERATURE OF THE MONTH.

IRON TRADE REVIEW.

JANUARY 5th.

"The Effect of Silicon on the Magnetic Permeability of Cast Iron," is the title of an article in the Electrical World of December 10, which Dr. Richard Moldenke summarizes in the Iron Trade Review as follows: Prof. Caldwell gives a brief summary of results obtained by testing several varieties of cast iron with varying percentages of silicon for their magnetic permeability. As this subject is of importance to the founder who makes dynamo castings, a summary of the results attained is given below. There are two conditions which must be taken into consideration: First, that the castings produced are of the proper physical character and can withstand the continuous heavy strains and vibrations incident to the use they are intended for; and secondly, that they be at the same time as permeable to the magnetizing force as possible. If a bar of iron is wound with insulated wire from end to end evenly and a current allowed to pass through this wire, the bar becomes magnetic. To express this condition numerically, the number of magnetic lines of force per unit of area of a section near the middle of this bar are given. In electrical parlance, this is designated by B. It is obtained by trial in each case and varies considerably, depending upon the strength of the magnetizing force. Thus, for an iron in which for a certain strength of magnetizing force B becomes 5,000, this will not become 10,000 when the force is doubled, but will fall short considerably. It is important, therefore, to use irons which will allow the application of a maximum of magnetizing force with efficient results. To return to the subject matter: Prof. Caldwell had the tests of the magnetic permeability of two Bessemer irons and a southern variety made at the Ohio State University. The silicon in the southern iron (Rockwood) ran from 1.87 to 4.27 per cent. in 11 casts. One of the Bessemers ran from 1.82 to 4.62 per cent. in 14 casts.

Curves were constructed from the data obtained and from these curves the magnetizing forces necessary to give densities (B) of 2,000, 5,000, 7,000 and 8,000 were obtained, and were again plotted in connection with the silicon percentages. The conclusions derived from the above were that the specific opposition to the magnetizing force on the part of all the irons tested decreased as the silicons rose from 1.8 to 4.6 per cent. For low densities, that is, where B is low, this decrease is proportional. Where B is up to 8,000 a silicon contents of 3.5 per cent. seems to be the limit for good efficiency and hence should not be exceeded. As a matter of fact it would be unsafe to exceed this silicon contents anyhow, for the shrinkage strains set up would make such castings very dangerous when subject to centrifugal force.

January 19.—Dr. R. Moldenke, in discussing an article by Prof. Martens, on "Testing Cast Irons" (in Zeitschrift des Vereins Deutscher Ingenieure, Vol. XLII.), says, in part: Prof. Martens gives the specifications for testing cast iron as formulated by the famous "Bauschinger" conferences at Munich, Dresden, Berlin and Vienna. These specifications are intended to give an opportunity to test the material in every way. Bars about 44 inches long and 1.2 inches square, with a piece 1x1x4.8 inches long attached to one end, are cast in dry sand with a slope of 1 to 10. The total vertical distance from top of gate to bottom of bar should equal 8 inches. * * * Special kinds of castings are to be tested in other ways suited to the purposes they are intended for. Prof. Martens criticises adversely Dr. Moldenke's suggestion that test bars be slightly contracted at the middle, to insure their breaking at that point, Dr. Moldenke conceding the force of his objections. The buyer of the casting, Prof. Martens says, in order to assure himself that he is getting the proper kind of material, will require a different line of tests from that of the founder who wants to know what his castings can stand in service. The relative advantages of the square, and the round form of test bar is touched upon in a spirit of liberality that would welcome a conclusion in favor of that which shall prove

to be the best. * * * Going now to the question of the daily run of foundry work, Prof. Martens calls attention to the fact that although the foundryman could readily learn much from the composition of his charges, and adjust these chemically, to meet his requirements, yet he will prefer a physical test. This is undoubtedly true and will probably always remain so, for the simple reason that, given two irons of the same chemical composition, one may be good and the other very bad, the question of the process of making the pig and then the casting being all-important. * * * Prof. Ledebur is quoted as recommending the following tests [for foundry use]: (a) A fluidity strip 10 inches long, 1 inch wide and 1-16 inch thick. This is gated at one end and the fluidity of the metal is judged by the distance it runs in the mold. (b) A wedge 1½ inches thick at the base and 8½ inches high. This, when broken to show the triangular cross section, will indicate the fracture of different thicknesses and the chilling tendency of the harder irons. (c) A chill test similar to the kind in daily use in all works. (d) A ribbed angle plate which shows up shrinkages readily. (e) A stove plate 2 feet square and not over 2-5 inch thick to show the tendency to warp and draw. (f) The contraction of the iron when cast to be measured on the bar which is to be tested. This is therefore prepared with special care. (g) Practical tests, by casting cylinders and pulleys which are machined or tested in any way calculated to show the availability of the metal for the purpose intended.

In America we would say that these recommendations are certainly good ones. Prof. Martens says that in Germany, as a rule, the bending test is the only one carried out, compression tests being a rarity, and the tensile test is but infrequently resorted to. The bending test, to the exclusion of the tensile, is unreliable under changing compositions.

Prof. Martens strikes the keynote of the whole subject when he points to the value of the impact test, the writer fully agreeing with him that this test may prove the most valuable of them all.

The tensile test is admittedly unreliable as now made, no

gripping device having yet been invented that satisfies all the conditions attending the process. The impossibility of avoiding transverse strains in the gripping of the specimen is the inherent trouble in the tensile test. The concensus of opinion is that further study is necessary to the working out of a generally acceptable system for testing cast iron.

IRON MOLDERS' JOURNAL.

R. D. Moore writes on the proper way to make and use pop-gates, etc. The pop-gate should be so tapered that it will break off just at the casting, leaving the least possible scar.

Hard ramming around gates causes the iron to boil, and makes dirty castings. Pouring gates, if made small, round, and set close to mold cavity will skim the iron well, and will act excellently as a feeder.

[We take exception to Mr. Moore's assertion that a small gate is a good skimmer. In a small gate, the downfalling stream will force the dirt into the mold, while in a large gate, the dross will escape to one side, and float in the gate, leaving ample room for the passage of the iron without its being carried along with it.—Ed.]

THE FOUNDRY.

Arch. Loudon describes the process of molding a 30-inch check valve in loam. The article is accompanied by six illustrations, assisting to an understanding of the steps taken in molding it.

Wm. Roxborough contributes another installment of his article on "Feeding or the Compression of Metals." The article is illustrated, showing where to set the feeding gates in order to effective service.

R. D. Moore writes on "Mending Holes in Retorts." A sectional view of a retort casting in position with the mold built upon it for mending is given, and the text gives all needed instruction concerning the process.

An illustrated article by C. Vickers gives design, construction and operation of brass furnaces.

Virgil Wolfe writes on the foundry foreman as a bookkeeper.

J. Temple McCartney discusses the proposition that indifference is a bar to progress among molders.

"Human Nature in the Foundry" is treated of by H. R. Ramp. A knowledge of human nature, and a wise adaptation of oneself to it, as it manifests itself in the employe, is essential to success in handling men to the best advantage in founding or other work. The wise, humane foreman, working in harmony with those under him, will produce better results with inadequate facilities than the man with the opposite characteristics could with the most expensive equipment.

B. F. Chambers, of Waterbury, Conn., gives his experience in melting metal borings in the cupola: After the heat was off, he put on a fresh charge of coke, then charged 2,400 pounds of cast iron borings, covering these again with coke, and with a light blast, melted them down, and ran the metal into pigs, finding, next day, that the product weighed 2,143 pounds. This was used in the regular soft iron mixture in proportion of 20 per cent. of remelted borings to 80 per cent. of pig iron and scrap, with good results.

A brief description of a cheap, quick method of making a name-plate pattern we here transcribe in full: To fit up a brass name-plate casting for a pattern by filing involves a good deal of labor, besides necessarily reducing the face of the letters too much, if sufficient draught is given. Instead of using the file, just lay the plate, face up, on a level bench; then melt some beeswax on it with a blowpipe, continuing the application of the flame till the plate becomes hot; then let it cool, and your pattern will be ready for use. If you choose to make the complete pattern without buying a casting for a starter, simply locate letters and figures to suit your fancy on a brass or iron plate and melt the wax upon it; when the wax cools it will be found to coat the whole surface evenly, giving the requisite bevel to the edges of the letters, filling narrow, difficult pockets so as to make them more shallow, as desired, and the letters will be firmly fixed to place; then make a casting from this and coat it thinly with wax and you will have an excellent pattern at nominal cost. This trick of melting wax onto patterns may be employed in many instances where draught cannot be otherwise conveniently given.

A method for making small cotter-pin holes in castings is described; also, a method is illustrated and described for making core prints by means of dies and punches.

An article on "Foundry Equipment," by "Setu Wright," makes a very strong and well sustained plea for better facilities in foundries generally.

R. H. Palmer "chats" with apprentice boys in a manner calculated to encourage them to develop the best there is in them.

W. J. Keep discusses the question of the per cent. of loss of iron in melting; also, the effect of cold short iron in foundry mixtures. Mr. Keep says, in part: * * * The terms cold short and hot short do not properly apply to cast iron; and * * * strength is very largely a question of grain and not of chemical composition, and the property of taking chill deos not accompany any definite chemical composition. By heating the chill the rate of cooling of the chilled portion of a casting may be retarded and the shrinkage lessened without necessarily diminishing the depth of chill.

THE TRADESMAN.

E. H. Putnam, writing on pattern-making, says: If the patternmaker would refrain from putting needless work on certain parts of the pattern, he would have more time to apply to those points where a great deal of work is necessary in order to the making of a good pattern. It is the corners, angles and holes that require the greatest amount of attention, and all these vital points may be badly slighted by the workman, and yet by nicely polishing the unimportant large areas the pattern may have the appearance of being nicely finished. * * * Nice judgment and discrimination should be employed to guard against spending too much time on unimportant patterns. Patterns that are to be used but once or twice should be quickly and cheaply made, and in this case a little advice with the foundry foreman may save much time.

The same writer urges the importance of molders supplying themselves with an ample stock of tools. The best workman, from all points of view, is the one with the best stock of tools. The fact that a man owns and uses many tools shows that he takes interest in his trade, has studied it with a view to perfecting himself therein, and such a man commands the respect of all, and is a good and useful citizen.